ing procured from foul or stagnant water. In this case the opinion of M. Dutertre, that the liver of poisonous mussels is the seat of disease and the generator of the poisonous leucomaine, seems confirmed; but I cannot agree with the French observer, that the disease is never the result of the poisonous nature of the food of the mussel. I have read all, or nearly all, the cases of mussel-poisoning on record, and I gather from such details as are given with respect to the places in which the mussels were found that they were in contact with sewage or stagnant water."

RECENT THEORIES OF GEOMETRICAL ISOMERISM.[1]

THE histologist places a section of organized tissue upon the stage of his microscope, and studies its structure. He reports upon the cells and their contents, for he has seen them, but he has not detected the molecule. The smallest discernible particle was probably an aggregate of at least a million molecules of elaborate structure, permeated by many times as many molecules of simpler composition.

The actual configuration of atoms in the molecule, the bonds by which they are united, the mechanism which effects transformations from one form to another, and, indeed, the very existence of molecules, are subjects which do not belong to the world of sight. It is not likely that any human eye, with the most perfect optical instruments, will ever penetrate these secrets of an unseen world.

But the many unseen worlds are favorite hunting-grounds of science. The imagination of the geologist sees successive strata in regular order or thrown into folds, where the rocks are hidden from the uninitiated by drift, soil, and forest, or even where they were long since removed by erosion. The astronomer, having discovered a simple law controlling the motions of the planets, pursues them with the formulas of dynamics and perturbations, until the unexplained residuals of motion lead him to the very spot occupied by Neptune. The biologist experiments upon the vitality of invisible germs, but the chemist reasons upon the elements that make up molecules of which these germs consist. He recognizes atoms having simple, double, triple, and quadruple power of union. Whatever be the nature of this union, the "bonds" are as real as ever held prisoner to Roman soldier. The structural formulas which characterize the language of modern chemistry express the fact that each atom is specially related to a certain one or more other atoms, with scarcely the least claim in regard to distance or direction.

The doctrine of valence and types prepared the way for the more elaborate doctrines embodied in structural formulas, which so admirably explain numerous re-actions and isomers. Such is our ignorance of the actual relations of the atoms in space, that no photographs of geometrical isomers can be offered for inspection; yet certain working hypotheses of their configuration, which were received for some years with great reserve, have recently had such influence in shaping the current of research in organic chemistry, that they are well worth our attention at this hour.

When the quadrivalent character of carbon was distinctly recognized, as in CH_4, it was probably not long before the regular tetrahedron often occurred to thinking minds as a suitable representation. If CH_4 thus represents the outline of a regular tetrahedron, it must not be supposed that the actual form is changeless, but rather that the mean positions of the hydrogen atoms are at the angles. In substitution products, we may think of the several radicles oscillating about mean positions that are at unequal distances from each other, the mutual attraction of the most unlike groups bringing them somewhat towards each other. The conditions in the two forms (see below) are so far identical that the mean mutual distance of any pair of groups will be the same in both. The difference would not be likely to make one form more easily soluble or volatile than the other. The usual means of distinguishing isomers may fail. Ordinary methods of fractional distillation or precipitation are alike useless to distinguish tweedledum and tweedledee. A most delicate instrument, capable of feeling the slightest resistance to the vibrations of luminiferous ether, is found in a ray of polarized light. When such a ray passes through the asymmetric molecule, it is probable that greater resistance will be met in some one plane than in another, and thus the plane of polarization is slightly turned. In a fluid aggregate, a ray will meet successive molecules in all possible positions; and while these must have unequal effects,—sometimes, perhaps, in opposite directions,—the mean result for a large number will always be the same.

Le Bel and van't Hoff were the first to state clearly (and independently) the fundamental principles upon which this branch of chemical investigation has been developed. In the first place, when carbon is linked with four different radicles, two isomers will usually result, the forms of the molecule being related to each other as an object to its image in a plane mirror. These isomers closely resemble each other in most physical and chemical properties. Two such atoms may be represented by tetrahedrons, united at the corners, where it is important to note the cyclical order of the radicles attached to each carbon atom as seen from that atom itself.

Our theory must conform, however, to the observed facts; otherwise we may either be overwhelmed with a multitude of imaginary isomers, or we may be unable to account for all that are discovered. The following principle (which has been known as "van't Hoff's second hypothesis") is supported by many facts: When two atoms of carbon are united by a single bond, each is capable of free rotation in either direction about the common axis; and isomers may be recognized for those bodies only which cannot be brought into the same configuration by such rotation. But some apparent exceptions must not be ignored, especially a marked exception to the principle of free rotation, announced two years ago by Auwers and V. Meyer.

Again, using the tetrahedron as the symbol of the carbon atom, we may conceive two such forms united on a common edge, with hydrogen at the four free corners, to represent the molecule of ethylene (C_2H_4). In like manner, acetylene derivatives may be represented by two tetrahedrons with a common face.

Finally the theory of rings was discussed. A campaign is thus being conducted towards the stronghold of atomic mysteries.

The current theories of stereochemistry or geometrical isomerism are based upon those residuals of observed facts that find no explanation in the usual doctrine of structural formulas. Any complete bibliography, covering all the experimental evidence that may bear upon this subject, must therefore include all reactions or properties that aid us in determining the constitution of the many compounds capable of appearing in geometrical isomers. In the list appended to Professor Warder's paper an attempt is made to include those papers only that may be most useful to chemists or physicists desiring to acquaint themselves with the history of the stereochemical conception, its originators, supporters, and opposers. The full value of Professor Warder's paper cannot be appreciated without the use of the many diagrams which are not available for our use.

[1] Abstract of an address before the American Association for the Advancement of Science, by Robert B. Warder, vice-president of Section C.

NOTES AND NEWS.

THE pressure of natural-gas wells in Indiana and Ohio is steadily diminishing, the diminution having already amounted to between 30 and 40 per cent. Professor Orton urges the imperative necessity of cities and States taking action to restrict wasteful use of gas; but even the strictest regulations, he says, cannot prevent the exhaustion of the supply in a few years. In this connection, says the *Engineering and Mining Journal*, it is interesting to note that the Pennsylvania Company has taken the step of refusing to sell natural gas in Erie, Penn., except by metre, charging 22½ cents per 1,000 cubic feet, in order to prevent waste of the gas. No factories are to be furnished at any point on its line, as all the gas will be used for domestic purposes.

—The American Folk-Lore Society will hold its annual meeting in New York City on Nov. 28 and 29, these dates being the Friday and Saturday following Thanksgiving Day. The sessions will be held at Columbia College, in rooms kindly placed at the disposition of the society by President Low. Last year the annual

meeting was held in Philadelphia, and was signalized by a large attendance and the formation of a local chapter of the national society, which has held meetings monthly throughout the winter. It is hoped that all persons interested in folk-lore will consider themselves invited to attend the meetings at Columbia College, when several interesting papers will be read, and that many will unite with the national society, as an increase in membership in New York and Brooklyn is desirable. The officers of the society for 1890 are as follows: president, Dr. Daniel G. Brinton (Philadelphia, Penn.); council, Hubert Howe Bancroft (San Francisco, Cal.), Franz Boas (Worcester, Mass.), H. Carrington Bolton (New York, N.Y.), Thomas Frederick Crane (Ithaca, N.Y.), Alice C. Fletcher (Nez Percés Agency, Idaho), Victor Guilloû (Philadelphia, Penn.), Horatio Hale (Clinton, Ont.), Mary Hemenway (Boston, Mass.), Henry W. Henshaw (Washington, D.C.), Thomas Wentworth Higginson (Cambridge, Mass.), William Preston Johnston (New Orleans, La.), Charles G. Leland (London, England), Otis T. Mason (Washington, D.C.); secretary, W. W. Newell (Cambridge, Mass.); treasurer, Henry Phillips, jun. (Philadelphia, Penn.). The society publishes the *Journal of American Folk-Lore*, a quarterly in octavo, bearing the imprint of Houghton, Mifflin, & Co. It is sent free to members. The membership fee is three dollars per annum. Persons desiring to join the society, or to receive the circular containing the particulars of the meeting, should address Dr. H. Carrington Bolton, University Club, New York City.

— Up till quite lately, says *Engineering* of Sept. 19, the whole of the guns for the Belgian Army were obtained from Essen; but, in the presence of the immense progress of the Belgian steel industries, it was only to be expected that an attempt would be made to change this state of affairs. A number of cannon were accordingly designed by the officers of the Belgian artillery, and manufactured in the Royal Foundry, Liége, from steel obtained from the Cockerill Company. Comparative tests of these guns and a number of Krupp guns of similar type were arranged, and have just been brought to a successful conclusion. In the first series of trials in which the ballistic qualities were to be tested, the guns selected had in each case a caliber of 5.9 inches; and a mortar, a howitzer, and a cannon of foreign and of domestic manufacture were selected. The Belgian mortar was 45 inches long, and weighed 8.2 hundredweight; while the corresponding Krupp gun was 37.4 inches long, and weighed 7.1 hundredweight. The Belgian howitzer was 83 inches long, and the Krupp 70.8 inches, whilst the dimensions of the cannons were more nearly equal. Both sets of guns were fired with the same charges, though these were above the proper limit for the Krupp guns, which must have been at a disadvantage in consequence. As was only to be expected under the conditions, the native-made guns gave somewhat better results, the ranges of the mortars and howitzers exceeding those of the Krupp guns by from 250 to 200 yards. The results with the cannon were practically identical.

—Experiments made at the Ohio Experiment Station for the past three years indicate that the plum curculio can be kept in check by spraying with Paris green or London purple in water solution. But, while this remedy was applicable to apples and plums, it could not safely be applied to peaches, because the foliage of the latter is so easily injured by the poison. Professor Bailey of the Cornell University station has been experimenting in spraying peaches this year, and in a bulletin just issued announces the following summary of his results: 1. Peach-trees are very susceptible to injury from arsenical sprays; 2. London purple is much more harmful to peach-trees than Paris green, and it should never be used upon them in any manner; 3. Injury is more liable to occur upon full-grown foliage and hardened shoots than upon young foliage and soft shoots; 4. The immunity of the young growth is due to its waxy covering; 5. Injury late in the season is more apparent than early in the season, because of the cessation of growth; 6. Injury from the use of London purple may be permanent and irreparable; 7. The length of time which the poison has been mixed appears to exercise no influence; 8. London purple contains much soluble arsenic (in some samples nearly 40 per cent), and this arsenic is the cause of injury to peach foliage; 9. A coarse spray appears to be more injurious than a fine one; 10. A rain following the application does not appear to augment the injury; 11. Meteorological conditions do not appear to influence results; 12. Spraying the peach with water in a bright and hot day does not scorch the foliage; 13. Paris green, in a fine spray, at the rate of one pound to 300 gallons of water, did not injure the trees. Probably one pound to 350 gallons is always safe.

—The following is a list in brief, according to *Nature*, of subjects on which the Dutch Society of Sciences at Haarlem invite research: a history of the mathematical and physical sciences in Holland; isomorphism; minerals in the river and dune sands on the Dutch coast; the accessory sexual glands in mammalia; heat liberated in solution of various salts in water; decomposition of water or other liquids by disruptive electric discharges within or on the surface; influence of compression in different directions on specific inductive power; determination of the form and position of the reticular micrometers used by Lacaille at the Cape of Good Hope; influence of volume of molecules on pressure of a gas; relation between density and chemical composition of transparent bodies, and the index of refraction; modification of reflected light by magnetization of some other metal than iron; methods of obtaining and fixing new varieties in cultivated plants; *rôle* of bacteria in filtration of potable waters through a layer of sand; bacteria and azotized combinations in the soil; healing after grafting.

—The last number of the *Kew Bulletin* contains a note on the properties and uses of the jarrah-wood, a species of eucalyptus native to western Australia. The main difficulties in connection with its use in this country are the cost of freight for such heavy timber from Australia, and its intense hardness, which makes it difficult, for ordinary English carpenters' tools, to work it. The tree which produces it grows generally to a height of a hundred feet, and sometimes a hundred and fifty feet. It is found only in western Australia, extending over the greater portion of the country from the Moore River to King George's Sound, forming mainly the forests of these tracts. According to Baron Mueller, when selected from hilly localities, cut while the sap is least active, and subsequently carefully dried, it proves impervious to the borings of insects. Vessels constructed solely of it have, after twenty-five years' constant service, remained perfectly sound, although not coppered.

—The steel-armor tests at Annapolis—the first armor-plate tests ever made in this country—were completed on Monday, Sept. 22. The plates used were one of solid steel with about 0.33 per cent of carbon; and the other of the composition known as nickel steel, being mild steel with 5 per cent of nickel; and a plate of a compound of steel and iron, under the Wilson patent. The plates were set side by side, and were backed with 36 inches of oak. The gun used on the first series of tests was a 6-inch rifle, 17 feet and a half in length. It was set with its muzzle 30 feet from the plates, and was mounted on a carriage, so that it could be turned to point squarely against any part of either plate. The projectiles were Holtzer chrome steel shells, 17 inches long, 6 inches in diameter, and weighing 100 pounds. The firing charge was 44½ pounds of cocoa-powder. The initial velocity was about 2,075 feet per second, giving a muzzle energy of 3,342,876 foot tons. Four shots were fired at each plate. Each plate was four feet high and 6 feet wide, and 10.5 inches thick. On Sept. 22 the tests were concluded by a shot at each plate with an 8-inch rifle firing an armor-piercing projectile. The projectile weighed 210 pounds, and was fired by a charge of 85 pounds of powder, giving an initial velocity of 1,850 feet per second. It appears from these tests, says *Engineering News*, that the solid steel armor is far superior to the compound armor having a hard steel face and a wrought iron back, when tested with modern high-power guns using armor-piercing projectiles. As regards the relative efficiency of the steel plate and the nickel-steel plate, the latter must be conceded to have proved, on the whole, the better defence, as it was not cracked by the 8-inch shot in the centre, as was the all steel plate. On the other hand, the penetration of the all steel plate was in almost every case less than that of the nickel steel, thus showing the latter to be somewhat softer and tougher than the former.